from their elements, are known. Actually, in order to know the heats of formation of 10,000 chemical compounds, including hydrocarbons, it is necessary to measure the heats of less than 10,000 different reactions, because of a simplifying rule for some of the higher hydrocarbons. With these 10,000 values, one can calculate the heats of many, many times that number of chemical reactions.

Fortunately for the peace of mind and the economic security of investigators in thermochemistry, the possibility of the complete compilation of the ultimate table of heats of formation is extremely remote, because, with the passing of time, some values are continually becoming obsolete with respect to accuracy, and furthermore, many new compounds whose heats of formation must be determined are continually being synthesized or discovered by the organic and inorganic chemists.

PALEONTOLOGY.—*Descriptions of Paleozoic fossils from the Central Basin of Tennessee.*[1] R. S. BASSLER, U. S. National Museum.

In a volume entitled "The Stratigraphy of the Central Basin of Tennessee," published in 1932 as Bulletin 38 of the Division of Geology of the State of Tennessee, the writer included plates illustrating the characteristic fossils of the various Paleozoic formations discussed. Among these guide fossils were forty-one new species of invertebrates and algae for which there was no place for their description in the text, although in the explanation of the plates the exact horizon and locality were given in addition in some instances to comparisons with well known forms. This stratigraphic volume was in press for several years, during which time the rules of nomenclature were changed so as to disallow the recognition of species figured but unaccompanied by descriptions. This article is issued to remedy this deficiency in the present case. For economy, the citations to the Tennessee volume are restricted to noting the plate and figure in parenthesis after each of the species. The types of all the following species are the property of the U. S. National Museum.

Solenopora compacta cerebrum Bassler, 1932 (pl. 12, figs. 1, 2)

This common widespread Ordovician alga is represented in the Hermitage formation by large, much convoluted masses resembling a brain, for which reason the varietal name *cerebrum* was proposed. Careful study of this

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genus will probably show the present variety to be worthy of specific standing.

Trenton (top of Hermitage): 6 miles northwest of Carthage, Tenn.

Buthotrephis inosculata Bassler, 1932 (pl. 9, fig. 3)

A fucoid alga consisting of rounded, slightly flattened stems 6 to 8 mm. in diameter, branching dichotomously in the same plain at intervals averaging 30 mm., and also penetrating limestone layers several feet thick until they are completely occupied with these remains.

Black River (Tyrone formation): Hoover's Mills, west of Woodbury, Tenn.

Licrophycus libana Bassler, 1932 (pl. 5, fig. 9)

This fucoid occurs so often on limestone surfaces in spreading, fanshaped fronds arising from a simple stem which by repeated division expands to a diameter of 50 mm. and often overlying each other so that it must represent the remains of a definite organism instead of inorganic markings as regarded by some authors. Although closely related to the type of the genus, *L. ottawense* Billings, the present species is distinguished by its smaller, narrower, shorter, more frequently dividing stems.

Stones River (Lebanon limestone): 2 miles south of Murfreesboro, Tenn

Camarocladia gracilis Bassler, 1932 (pl. 8, fig. 4)

This primitive spongelike organism of uncertain classification is distinguished from the genotype, *C. dichotoma* Ulrich and Winchell, by its stouter, less regularly dividing branches. *C. rugosa* Ulrich, a related species, is still unfigured and all the fossils of this nature require more study.

Black River (Tyrone limestone): Near Dixon Springs, Tenn.

Camarocladia implicatum Bassler, 1932 (pl. 5, fig. 10)

Similar to the preceding in general characters but differing in that the branches are 5 mm. wide, divide at intervals of 15 or more mm., and form a closely matted mass.

Stones River (Lebanon limestone): Lebanon, Tenn.

Saccospongia massalis Bassler, 1932 (pl. 15, figs. 3, 4)

Sponge forming masses of 160 or more mm. in height and width, composed of frequently dividing, closely united branches about 15 mm. in diameter, each with a central canal 7 or 8 mm. wide and with the usual porous structure of *Saccospongia* visible at the surface, three of the pores occurring in 10 mm.

Trenton (Cannon limestone): 2 miles east of Hartsville, Tenn.

Saccospongia laxata Bassler, 1932 (pl. 15, figs. 1, 2)

A branching sponge similar to *S. danvillensis* Ulrich in growth, but differing in the much larger pores of its network, 4 occurring in 10 mm. longitudinally in contrast to 7 of the mentioned related species.

Trenton (Cannon limestone): Near Carthage, Tenn.

Cryptophragmus arbusculus Bassler, 1932 (pl. 16, fig. 9)

Hydrozoon with the transverse partitions and other internal structure

of *C. antiquatus* Raymond, the genotype, but with a stout, frequently branched colony, the branches averaging 10 mm. in diameter.

Trenton (Cannon limestone): 4½ miles east of Hartsville, Tenn.

Tetradium? carterensis Bassler, 1932 (pl. 7, figs. 2, 3)

Coral of solid cylindrical stems, 30 to 40 mm. in diameter, composed of somewhat flattened corallites about 2 mm. in their longer diameter, showing a tendency to imbricate. No septa observed; generic position doubtful.

Black River (Carters limestone): 2 miles southeast of Priest, Tenn.

Tetradium saffordi Bassler, 1932 (pl. 19, fig. 2)

Colony a reticulate mass made by cells having the characteristic 4 septa and arranged in chainlike unilinear or bilinear rows uniting so as to form broad meshes 20 mm. in diameter.

Trenton (Cannon limestone): 2 miles east of Milton, Tenn.

Tetradium laxum Bassler, 1932 (pl. 18, figs. 10–12)

Corallite with septal structure of *Tetradium*, forming masses 70 or more mm. in diameter consisting of loosely growing single tubes each about 1 mm. in diameter, sometimes isolated but often adhering in unilinear sheets, all forming an open network with meshes averaging 7 mm. in width.

Trenton (Cannon limestone): 2 miles east of Hartsville, Tenn.

Tetradium ulrichi Bassler, 1932 (pl. 19, fig. 1)

Like *T. saffordi* Bassler in general growth and structure, but meshes are only about half as broad.

Trenton (Cannon limestone): 2½ miles northwest of Woodbury, Tenn.

Columnaria [alveolata] minor Bassler, 1932 (pl. 11, figs. 1, 2)

Corallum small, composed of polygonal thin-walled corallites in close contact, 2½ mm. wide when mature, each with a primary set of 12 septa extending well towards the center and a shorter secondary set. The small corallites distinguish this species which was figured as a variety, since 5 mm. is the average width in *C. alveolata*.

Trenton (Basal Hermitage): 1 mile south of Belfast, Tenn.

Nyctopora [Columnaria] crenulata Bassler, 1932 (pl. 13, figs. 3, 4)

Corallum of small, rounded masses composed of polygonal thin-walled corallites in close contact, with 5 to 6 in 6 mm., each corallite with 8 primary septa extending a short distance into the tubes and a set of shorter secondary septa. Tabulae in two zones, a crowded one where two occur in a tube diameter, and the other where they are spaced on an average of a tube diameter apart. No mural pores.

Trenton (top of Hermitage): 4 miles south of Carthage, Tenn.

Lichenaria globularis Bassler, 1932 (pl. 13, figs. 1, 2)

Small globular masses, composed of polygonal, thin-walled corallites with 8 to 9 in 6 mm., without septa or mural pores. Tabulae developed at intervals of twice the tube diameter in the uncrowded zone, but in the other zone 2 or 3 occur in the same space.

Trenton (top of Hermitage): 6 miles northwest of Carthage, Tenn.

Lichenaria grandis Bassler, 1932 (pl. 12, figs. 7, 8)

Similar to *L. globularis* but more massive and with larger corallites, of which there are 6 in 6 mm. Septa absent; tabulae present and spaced as in the previous species.

Trenton (top of Hermitage): Near Bradyville, Tenn.

Enopleura punctata Bassler, 1932 (pl. 18, fig. 9)

This well marked cystid is distinguished from the genotype, *E. balanoides* (Meek) by its flattened theca and especially by its highly punctate surface.

Trenton (Cannon limestone): ½ mile north-northeast of Pulaski, Tenn.

Scolithus columbina Bassler, 1932 (pl. 16, fig. 8)

Type specimen a piece of fine-grained dove limestone pierced by worm borings, tubes about 0 5 mm. in diameter filled by crystalline calcite and spaced at intervals of several mm. The minuteness of the borings distinguish this from all other species.

Trenton (base of Cannon limestone): Near Franklin, Tenn.

Amplexopora convoluta Bassler, 1932 (pl. 12, figs. 3, 4)

Bryozoan zoarium, a convoluted mass of 40 or more mm. in diameter, made up of closely intertwining branches composed of angular zooecia with the wall and acanthopore structure of *Amplexopora* and with 8 occurring in 2 mm. In vertical sections the immature region has diaphragms at intervals of 3 to 4 tube diameters, but in the mature zone 3 occur in one tube diameter.

Trenton (top of Hermitage): 2 miles west of Hartsville, Tenn.

Stellipora stipata Bassler, 1932 (pl. 11, figs. 3, 4)

Zoarium of incrusting lamellae with closely spaced star clusters in which the rays are narrow and leave little space between them for mesospores. In the genotype, *S. antheloidea* Hall, the clusters are much farther apart and each exhibits at its center a broad area of mesopores.

Trenton (top of Hermitage): 2 miles east of Cottage Home, Tenn.

Lioclemella bifurcata Bassler, 1932 (pl. 25, fig. 21)

Similar to the genotype, *L. ohioensis* Foerste, in zooecial structure and pointed base for articulation, but differing in that the zoarium bifurcates forming a distinct prong-shaped object; the zooecia are smaller (8 in 2 mm.) and the mesopores smaller and more numerous.

Richmond (Fernvale formation): 2½ miles northwest of Pulaski, Tenn.

Sowerbyella lebanonensis Bassler, 1932 (pl. 5, figs. 7, 8)

Brachiopod shell similar to *S clarksvillensis* and related species, but distinguished by the surface markings of very fine striae with 3 or 4 delicate ribs alternating with a single larger one, with cardinal extremities somewhat angular and the dorsal lamellae extending almost to the front of the valve. Surface flat to gentle convex.

Stones River (Lebanon limestone): Shelbyville, Tenn.

Rafinesquina hermitagensis Bassler, 1932 (pl. 12, figs. 5, 6)

Shell of *R. fracta* group but rather strongly convex in the median region

and without any geniculation. Differs also in the greater breadth of the valves in contrast with the length, an average shell being 22 mm. long by 30 mm. wide.

Trenton (near base of Hermitage): 2 miles south of Middleton, Tenn.

Strophomena odessae Bassler, 1932 (pl. 25, figs. 7–12)

Shell similar to *S. parvula* Foerste, but differing in its general proportions, smaller size, less angular cardinal extremities and finer surface markings.

Richmond (Fernvale formation): 2½ miles northwest of Pulaski, Tenn.

Tentaculites obliquus Bassler, 1932 (pl. 11, fig. 9)

Shell 8–10 mm. long, 1 mm. in greatest diameter, differing from other species of the genus in its slightly curved form.

Trenton (Hermitage formation): Danville, Ky.

Hormotoma columbina Bassler, 1932 (pl. 18, figs. 1, 2)

Shell similar to *H. major* Hall, differing in a smaller apical angle making it narrower and less robust. *S trentonensis* Ulrich and Scofield is also similar but is a shorter and more rapidly enlarging shell.

Trenton (Cannon limestone): 1 mile southwest of Franklin, Tenn.

Lophospira ulrichi Bassler, 1932 (pl. 17, figs. 5, 6)

Related to *L sumnerensis* Safford, but characterized by its low spire and unusual breadth. An average shell measures 22×22 mm.

Trenton (Cannon limestone): Near Hartsville, Tenn.

Ctenodonta hermitagensis Bassler, 1932 (pl. 11, figs. 7, 8)

Similar to *Ctenodonta pectunculoides* in general outline and dentition, but shell smaller and beak more produced with general surface marked by strong concentric lines.

Trenton (top of Hermitage): 3 miles east of Mt. Pleasant, Tenn.

Leperditia pondi Ulrich and Bassler 1932 (pl. 21, fig. 8)

A *Leperditia* with valves 16×12 mm., in length and height, characterized by the unusually equal curvature of both anterior and posterior ends. Surface smooth with a narrow rim and slightly developed ocular tubercle in the anterior dorsal third.

Trenton (Catheys formation): Nashville, Tenn.

Isochilina apicalis Ulrich and Bassler, 1932 (pl. 21, fig. 9)

An *Isochilina* with valves about 11 by 6½ mm. with eye tubercle close to the dorsal margin and a ridge almost one third the length of the valves just below the center and parallel to the hinge line.

Trenton (Catheys formation): Nashville, Tenn.

Isochilina columbina Bassler, 1932 (pl. 17, fig. 2)

A narrow, elongate *Isochilina* with dimensions of about 9×5 mm. with smooth surface, no marginal rim and a minute eye spot close to the anterior dorsal angles.

Trenton (Cannon limestone): Nashville, Tenn.

Isochilina nelsoni Ulrich and Bassler, 1932 (pl. 21, fig. 10)

Carapace equivalved, each valve about 13×7 mm., with surface smooth and a narrow rim along the free margins and with well developed ocular protuberance and accompanying nodes in the dorsal section.
Trenton (Catheys formation): Nashville, Tenn.

Aechmina longicornis Ulrich and Bassler, 1932 (pl. 27, fig. 6)

An *Aechmina* distinguished by the spine arising from the anterior half of the dorsal edge of the valves, which has a broad base and narrows to a point abruptly. A row of minute spicules occurs along the free margin of the valve. Valves excluding spine 0.9×0.5 mm.; spine 0.7 mm. long.
Kinderhook (Ridgetop shale): Mt. Pleasant, Tenn.

Ulrichia tenuimuralis Ulrich and Bassler, 1932 (pl. 27, fig. 14)

This species is particularly marked by the presence of a ridge close to the free margin and by a large oval node occupying the central part of the dorsal half of the valve. A smaller node anterior to this and the reticulate surface complete its characters. Valves 1 by 0.6 mm.
Kinderhook (Ridgetop shale): Mt. Pleasant, Tenn.

Paracythere cornuta Ulrich and Bassler, 1932 (pl. 27, fig. 13)

A Cythere-like ostracod with a small but prominent node near the dorsal in the narrow anterior part, with a much broader posterior end, and with surface marked by concentric lines arranged around a small muscle spot posterior to the node. Valves 1 by 0 6. mm.
Kinderhook (Ridgetop shale): Mt. Pleasant, Tenn.

Monoceratina [Bursulella] tennesseensis Ulrich and Bassler, 1932 (pl. 27, figs. 11, 12)

A subtriangular-shaped ostracod with the apex of the triangle below and formed by the continuation of the ventral edge into a strong prominent spine. Valve excluding spine 1.5 by 1.1 mm.
Kinderhook (Ridgetop shale): Mt. Pleasant, Tenn.

Beyrichiopsis modesta Ulrich and Bassler, 1932 (pl. 27, fig. 10)

This species differs from the genotype, *B. fimbriata* Jones and Kirkby, in that the surface markings are reduced to a single, small rounded post-median node, and that the frill extending from the edges of the valve is of more uniform diameter throughout. Valve with frill 1 by 0.6 mm.
Kinderhook (Ridgetop shale): Mt. Pleasant, Tenn.

Beyrichiopsis pulchra Ulrich and Bassler, 1932 (pl. 27, fig. 1)

Distinguished from the associated *B. modesta* by its larger proportions, the very spinous surface, the small rounded subventral node and especially the double row of spines representing the frill paralleling the free edges. Valve measuring 1.8 mm. by 1 mm.
Kinderhook (Ridgetop shale): Mt. Pleasant, Tenn.

Allostraca fimbriata Ulrich and Bassler, 1932 (pl. 27, fig. 5)

This, the only known species of the genus, is distinguished by its Cythere-like valves with a very broad subcentral eye or muscle spot, a distinctly

granular surface, and a prominent striated frill extending some distance beyond the free edges of the valves. Valve including frill 1.6 mm. by 0.8 mm.
Kinderhook (Ridgetop shale): Mt. Pleasant, Tenn.

Paracythere granopunctata Ulrich and Bassler, 1932 (pl. 27, fig. 4)

Outline and surface markings of valve much as in *Allostraca fimbriata* except that the striated marginal rim of the latter is lacking. Valve 1.7 mm. by 1 mm.
Kinderhook (Ridgetop shale): Mt. Pleasant, Tenn.

Barychilina lineata Ulrich and Bassler, 1932 (pl. 27, figs. 2, 3)

Distinguished from other species of the genus by the delicate concentric lineate structure of the surface markings. Valves 1 6 mm. by 0.9 mm.
Kinderhook (Ridgetop shale): Mt. Pleasant, Tenn.

HYDROLOGY.—*Indian Hot Springs, Graham County, Arizona.*[1]

M. M. KNECHTEL, U. S. Geological Survey. (Communicated by O. E. MEINZER.)

The health resort known as Indian Hot Springs, at Eden, Arizona, is in sec. 17, T. 5 S., R. 24 E., about 8 miles northwest of the town of Pima, Arizona. (See fig. 1.) Here 5 thermal springs and a flowing well,

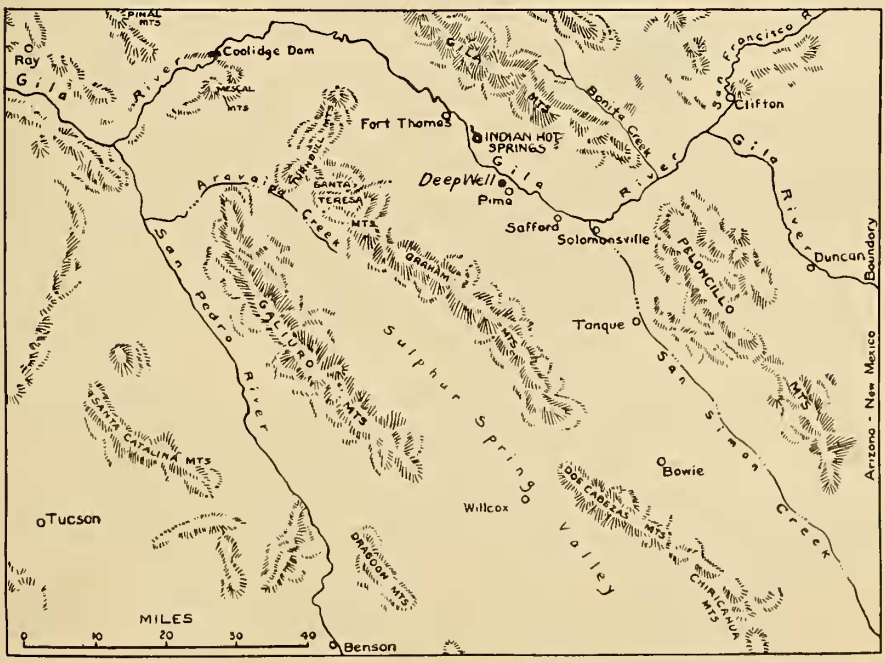

Fig. 1.—Map of part of southeastern Arizona, showing location of Indian Hot Springs.

[1] Published with permission of the Director of the United States Geological Survey. Received June 10, 1935.